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Design And Analysis Of Leaf Spring In A Heavy Truck

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Abstract: **A leaf spring is a simple form of spring, commonly used for the suspension in wheeled vehicles. Leaf Springs are long and narrow plates attached to the frame of a trailer that rest above or below the trailer's axle. There are** monoleaf springs**, or single-leaf springs, that consist of simply one plate of spring steel. These are usually thick in the middle and taper out toward the end, and they don't typically offer too much strength and suspension for towed vehicles. Drivers looking to tow heavier loads typically use** multileaf springs**, which consist of several leaf springs of varying length stacked on top of each other. The shorter the leaf spring, the closer to the bottom it will be, giving it the same semielliptical shape a single leaf spring gets from being thicker in the middle. Springs will fail from fatigue caused by the repeated flexing of the spring. The aim of the project is to design and model a leaf spring according to the loads applied. Presently used material for leaf spring are forged steel. In this project we are going to design leaf spring for the materials Mild Steel and composite material Glass Carbon by varying reinforcement angle. We are going to check the strength variations while changing reinforcement angle. For validating this design we are conducting FEA Structural Analysis is done on the leaf spring by using two different materials Mild Steel and Glass Carbon. Modal and fatiuge Analysis is also done. Pro/Engineer software is used for modeling and ANSYS is used for analysis.**

Keywords: **Leaf Spring; Composite Materials ; Creo; ANSYS;**

I. INTRODUCTION

Leaf springs square measure in the principal applied in suspension structures to soak up shock masses in automobiles like light-weight motorcars, big obligation trucks and in rail structures. It carries lateral loads, brake torsion, driving torsion additionally to surprise riveting

Originally called laminated or carriage spring, a spring can be a clean kind of spring, frequently used for the suspension in wheeled cars. It is additionally one many of the oldest kinds of springing, geological relationship back to medieval times. Typically stated as a semi-elliptical spring or cart spring, it takes the shape of a slim arcshaped duration of spring metallic of square cross section.

Actually, there is nearly a proper away quotient among the burden of the automobile and its fuel intake, substantially in town driving. The advanced composite materials like carbon, Carbon, Kevlar and Glass with suitable resins rectangular measure huge used due to their high precise electricity (strength/density) and high unique modulus (modulus/density). Advanced composite materials seem ideally fitted to suspension (leaf spring) applications. Their elastic houses can be tailor-made to extend the power and cut back the stresses evoked at some stage in application.

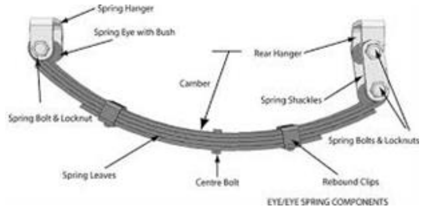


Fig: spring

The goal of this paintings is to fashion the EGlass/Epoxy composite spring while now not change in stiffness for car mechanical machine and analyze it. This could be accomplished to understand the following.

• To the update fashionable metallic springs with Eglass/Epoxy composite leaf spring at the same time as not modification in stiffness.

• to realize full-size weight loss inside the mechanical machine by commutation metal spring with composite spring.

II. PPRINCIPLE OF LEAF SPRING

The suspension spring is one some of the capability things for weight reduction in car as it accounts for 10 to simple fraction of the unsprung weight. The creation of composites helps in making plans bettera much higherplentiful betterhighera more potenta betterstepped forward mechanical system with better ride great if it will likely be carried out even as now not lots growth in fee and decrease in satisfactory and responsibleness. Inside the style of springs, strain power turns into the maximum vital problem. The hyperlink of the right pressure strength might be expressed as two U E =σ ρ/ anywhere σ is that the strength, ρ is that the density and E is that the Young's Modulus of the spring cloth It could be genuinely discovered that cloth having lower modulus and density could have a larger unique stress power capability. The creation of composite substances created it possible to scale back the burden of the spring while not discount of load wearing capability and stiffness because of the subsequent elements of composite materials as compared to metal.

Fig: Arrangement of spring in very automobile Model

III. PROBLEM DEFINITION

Objective of present paintings is to think about companion current car spring model TATA recreation EZRR PARABOLIC REAR and to fashion and examine a composite spring with upturned eye while now not dynamical stiffness to be able to alternate the triumphing metallic spring with a composite spring. A spring eye is honestly the top of a springunerect right into a round form to permit rotation concerning the spring eye. The maximum styles of spring eye stylessquare measure upturned, military wrapper, down grew to become, and Berlin eyes Fig: 4. Sorts Upturned eyes rectangular measure the foremost unremarkably used type of spring eye because of their trustworthy style and excessive durability. Upturned eyes square degree extraordinarily strong due to they withstand pressure because of vertical forces on a suspension.

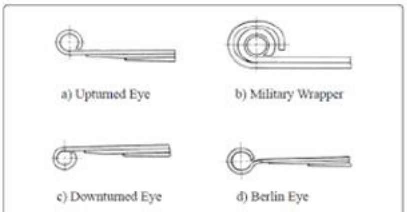


Figure 10: Types of spring eyes

Fig: Types of Spring Eyes

IV. WHY A COMPOSITE

Over the closing thirty years composite substances, plastics and ceramics are the dominant rising materials. The quantity and variety of programs of composite materials have mature regular, penetrating and conquest new markets unrelentingly. Ultra-modern composite materials represent a huge proportion of the designed substances marketplace beginning from ordinary product to elegant niche programs. Whereas composites have already tried their cost as weight-saving materials, the existing challenge is to form them cost effective.

V. DESIGN OF LEAF SPRING

CALCULATIONS FOR RADIUS AND LENGTHS OF LEAVES

Specifications of Ashok Leyland Viking

When n=10, Rear suspension

Number of leaf springs = 4

Overall length of the spring = $2L_1$ = 137.2cm = 1372mm

Width of leaves = 76.2 = 80mm

Number of full length leaves = 2 = n_f

Number of graduated leaves = 8 = N_g

Number of springs = 10 (N_g+N_f)

Center load = 2W =115 tones = 11500kg

2W =11500×9.8 = 112700N

2W = 112700/4 = 28175N

$$2W = \frac{total\ load}{no\ of\ springs} = 28175N$$

W = 14087.5N

VI. LITERATURE REVEIW

DESIGN AND ANALYSIS OF COMPOSITE LEAF SPRING FOR LIGHT VEHICLES

ABSTRACT: - Reducing weight even as growing or maintaining power of merchandise is attending to be especially essential studies problem in this modern world. Composite materials are one of the cloth households which can be attracting researchers and being solutions of such problem. In this paper we describe layout and analysis of composite leaf spring. The objective is to examine the stresses and weight saving of composite leaf spring with that of metallic leaf spring. The layout constraint is stiffness. The Automobile Industry has awesome hobby for substitute of metallic leaf spring with that of composite leaf spring, because the composite substances has excessive energy to weight ratio, appropriate corrosion resistance. The cloth decided on changed into glass fiber reinforced polymer (E-glass/epoxy), carbon epoxy and graphite epoxy is used towards traditional metal. The design parameters had been decided on and analyzed with the goal of minimizing weight of the composite leaf spring compared to the metal leaf spring. The leaf spring become modeled in Auto-

CAD 2012 and the analysis became performed using ANSYS nine.0 software. Keywords: - stiffness, composite leaf spring, metallic leaf spring, ANSYS 9.Zero, Auto-CAD 2012

INTRODUCTION TO CAD

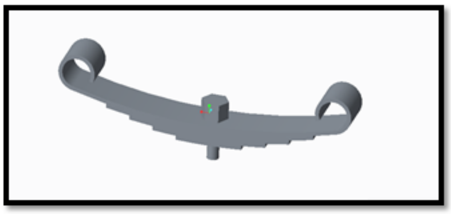
Computer-aided design (CAD) is using laptop structures (or workstations) to aid within the advent, change, analysis, or optimization of a layout. CAD software is used to increase the productiveness of the clothier, improve the great of layout, improve communications via documentation, and to create a database for production. CAD output is frequently within the form of digital documents for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

INTRODUCTION TO CREO

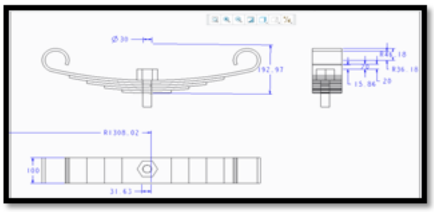
PTC CREO, formerly referred to as Pro/ENGINEER, is 3D modeling software used in mechanical engineering, design, manufacturing, and in CAD drafting carrier firms. It turned into one of the first 3-d CAD modeling programs that used a rule-primarily based parametric device. Using parameters, dimensions and functions to capture the behavior of the product, it is able to optimize the development product in addition to the design itself.

The name become changed in 2010 from Pro/ENGINEER Wildfire to CREO. It was introduced through the organisation who developed it, Parametric Technology Company (PTC), all through the release of its suite of design products that includes programs which includes assembly modeling, 2D orthographic views for technical drawing, finite detail analysis and greater.

3D MODEL OF LEAF SPRING



2D MODEL OF LEAF SPRING



INTRODUCTION TO FEA

Finite element evaluation is a technique of solving, normally approximately, certain problems in engineering and science. It is used specially for troubles for which no precise solution, expressible in a few mathematical shape, is available. As such, it is a numerical in preference to an analytical technique. Methods of this type are wanted due to the fact analytical strategies cannot cope with the real, complicated troubles which can be met with in engineering. For instance, engineering electricity of substances or the mathematical principle of elasticity may be used to calculate analytically the stresses and lines in a bent beam, but neither will be very successful in locating out what's going on in a part of a car suspension device for the duration of cornering.

INTRODUCTION

ANSYS is wellknown-reason finite detail evaluation (FEA) software bundle. Finite Element Analysis is a numerical method of deconstructing a complicated system into very small pieces (of person-exact length) called factors. The software implements equations that govern the behaviour of these factors and solves all of them; creating a comprehensive clarification of ways the machine acts as a whole. These outcomes then can be offered in tabulated, or graphical forms. This kind of analysis is typically used for the layout and optimization of a machine some distance too complex to analyze by hand. Systems that may match into this category are too complicated due to their geometry, scale, or governing equations.

STRUCTURAL AND FATIGUE ANALYSIS OF LEAF SPRING

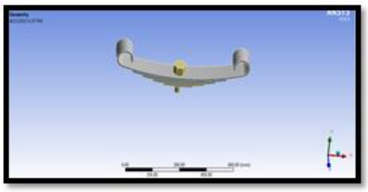
CASE 1:- MATERIAL - MILD STEEL

Save CREO Model as .iges format

→→Ansys → Workbench→ Select analysis system → static structural → double click

→→Select geometry → right click → import geometry → select browse →open part → ok

→→ select mesh on work bench → right click →edit



Double click on geometry → select geometries → edit material →

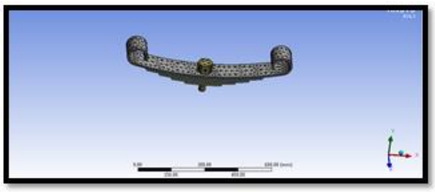
MATERIAL PROPERTIES OF STEEL

Density : 0.00000785kg/mm^3

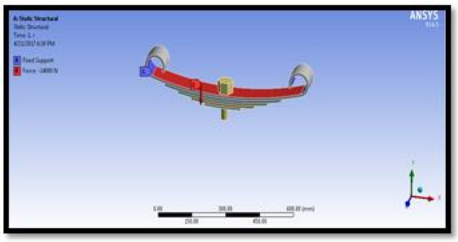
Young's modulus : 20000Mpa

passions ratio : 0.3

Select mesh on left side part tree → right click → generate mesh →



Select static structural right click → insert → select force -14088 N



Select displacement → select required area → click on apply → put X,Y,Z component zero →

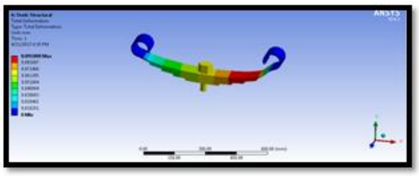
Select solution right click → solve →

Solution right click → insert → deformation → total → Solution right click → insert → strain → equivant (von-mises) →

Solution right click → insert → stress → equivant (von-mises) →

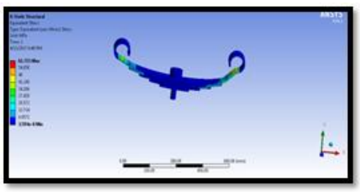
Right click on deformation → evaluate all result

TOTAL DEFORMATION



according to the contour plot, the maximum deformation0.091808 mm at master leaf because of load applied on the area and minimum deformation at eyes because of fixed on areas.

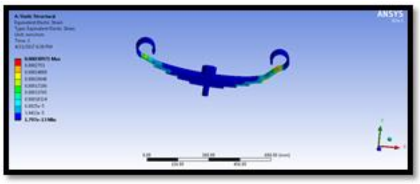
VON-MISES STRESS



According to the contour plot, the maximum stress at eyes because of fixed on areas and minimum stress at master leaf because of load applied on the area.

The minimum stress value is 3.594e-8 and maximum value is 61.715 N/mm^2

VON-MISES STRAIN



According to the contour plot, the maximum strain at eyes because of fixed on areas and minimum strain at master leaf because of load applied on the area.

The minimum strain value is 1.797e-13 and maximum value is 0.00030971.

MODAL ANALYSIS

Save CREO Model as .iges format

→→Ansys → Workbench→ Select analysis system → model → double click

→→Select geometry → right click → import geometry → select browse →open part → ok

→→ select mesh on work bench → right click →edit

Double click on geometry → select geometries → edit material →

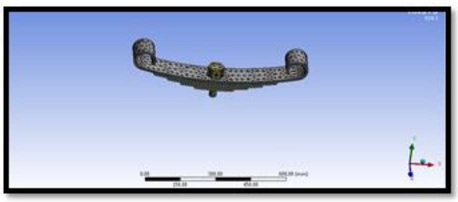
MATERIAL PROPERTIES OF STEEL

Density : 0.00000785kg/mm^3

Young's modulus : 20000Mpa

passions ratio : 0.3

Select mesh on left side part tree → right click → generate mesh →



Select displacement → select required area → click on apply → put X,Y,Z component zero →

Select solution right click → solve →

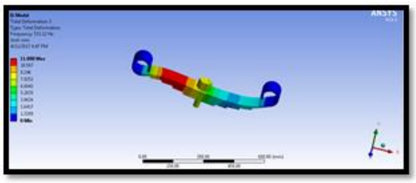
Solution right click → insert → deformation → total deformation → mode 1

Solution right click → insert → deformation → total deformation2 → mode 2

Solution right click → insert → deformation → total deformation 3→ mode 3

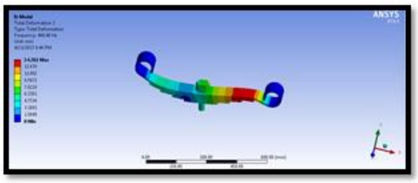
Right click on deformation → evaluate all result

TOTAL DEFORMATION



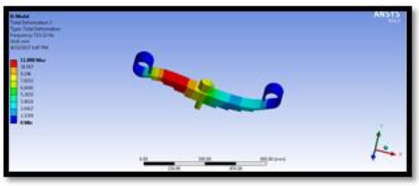
according to the contour plot, the maximum deformation11.888 mm at master leaf because of load applied on the area and minimum deformation at eyes because of fixed on areas.

TOTAL DEFORMATION 2



according to the contour plot, the maximum deformation14.261 mm at master leaf because of load applied on the area and minimum deformation at eyes because of fixed on areas.

TOTAL DEFORMATION 3



according to the contour plot, the maximum deformation11.888 mm at master leaf because of load applied on the area and minimum deformation at eyes because of fixed on areas.

VII. RESULTS AND DISCUSSIONS

STRUCTURAL ANALYSIS

	Mild steel	Glass fibre
Deformation (mm)	0.091808	0.85182
STRESS (N/mm^2)	61.715	26.743
STRAIN	0.00030971	0.0029976

VIII. CONCLUSION

In this thesis, a leaf spring is designed for Ashok Leyland Viking heavy vehicle. The data is collected from net for the specifications of the model. The leaf spring is designed for the load of 14087.5N. Theoretical calculations have been calculated for leaf spring dimensions at different cases like varying thickness, camber, span and no. of leaves by mathematical approach. In this thesis, analysis have been done by taking materials steel, carbon Epoxy.

Structural and modal analysis are conducted on total assembly of leaf spring and for single leaf by using layer stacking analysis, this analysis is done for only composites. The results show:

1. The stresses in the composite leaf spring of design are much lower than that of the allowable stress.
2. The strength to weight ratio is higher for composite leaf spring than conventional steel spring with similar design.
3. Weight of the composite spring by using material S_2 Glass fibre 5 times less than steel. For less weight of the spring mechanical efficiency will be increased.

In this project it can be concluded that using composite glass fibre is advantageous.

The major disadvantages of composite leaf spring are the matrix material has low chipping resistance when it is subjected to poor road environments which may break some fibers in the lower portion of the spring. This may result in a loss of capability to share flexural stiffness. But this depends on the condition of the road. In normal road condition, this type of problem will not be there. Composite leaf springs made of polymer matrix composites have high strength retention on ageing at severe environments.

The steel leaf spring width is kept constant and variation of natural frequency with leaf thickness, span, camber and numbers of leaves are studied. It is observed from the present work that the natural frequency increases with increase of camber and almost constant with number of leaves, but natural frequency decreases with increase of span. The natural frequencies of various parametric combinations are compared with the excitation frequency for different road irregularities. The values of natural frequencies and excitation frequencies are the same for both the springs as the geometric parameters of the spring are almost same except for number of leaves.

IX. FUTURE SCOPE

By this project result, in future we can use composite material by replacing steel material. But Experimental work have to done on this on this project like bending, torsion, hardness.

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